Riding Out the Storm

Raising hurricane awareness

Already into another hurricane season, which began June 1 and lasts until November 1, the center has once again reviewed and updated plans for responding to hurricanes.

Every year the Hurricane Rideout Team participates in a drill called "Hurricane Polly." This drill takes the team through the actual progression of a storm development, movement, and predicted landfall. The simulation is very accurate as to the data presented and what threats a real hurricane may pose. The simulation progressively provides data to the HRT, and the HRT makes decisions based on the data presented. After the simulation, the HRT evaluates the decisions and develops lessons learned as well as implementing any needed changes to the hurricane plan.

Bill Roeh, HRT captain, states, "The 'Hurricane Polly' exercise provides us with the opportunity to make decisions as if they were real time and understand the consequences of those decisions. 'Hurricane Polly' has taught us that we have to make decisions on implementing the different levels of the JSC Hurricane Plan as early as possible."

One rule of thumb that the National Weather Service suggests using for hurricane response is to plan for one category of storm higher than expected and plan 12 hours sooner than expected. While today's predicting and evaluation methods have proved to be fairly accurate, hurricanes can still be unpredictable in their path and destructibility. A prime example of this was Hurricane Bret, which last year formed off the western part of the Yucatan and was predicted to make landfall in the mid-coast of Mexico. Bret did not cooperate with the predictors, headed north, and became a Category 4 storm. Landfall was finally below Corpus Christi, fortunately missing highly populated areas.

During hurricane season, all organizations across the center should review their state of readiness. It is much easier to keep laydown areas orderly and neat rather than having to scramble at the last minute to secure everything. If a storm enters the Gulf of Mexico and is a threat to JSC, the center will initiate Level 4 preparations within 72 hours of predicted 59 mph winds at JSC. Level 4 preparations are basic activities that begin securing the site. If there is a high probability that a storm will pose a threat to JSC within 48 hours, Level 3 activities will be initiated by the director of Center Operations. Level 3 activities prepare JSC to be able to close down in a timely manner. When a storm threatens JSC within 36 hours, the center will move to Level 2. Level 2 places the center in the final state of preparation. Many systems will be deactivated. The center director makes the decision when to release all employees. Level 1 activities are initiated by the center director when an imminent threat to the center exists within 24 hours. The center will likely be closed before Level 1.

"One lesson learned from past experience is to do as much as possible during daylight hours. Therefore, the HRT may recommend going to a certain level before the times that are called for in the plan," said Roeh.

The timelines for the different levels of activity have been coordinated to allow all employees to have adequate time to initiate their preparation and evacuation. Safety of the employees is the highest concern. There are more than 800,000 people who may have to evacuate the coastal areas around Galveston County in the event of a major storm. To ensure that you have the ability to evacuate, you should plan to leave the area as soon as possible. For example, if you live in League City, you will want to evacuate before Galveston is given orders to evacuate. Plan your evacuation route ahead of time.

While strong winds and heavy rains can pose a threat to human life and property, the most dangerous element of a hurricane is the storm surge. Tides of 3 feet to 10 feet are common for even moderate storms. Add to that the wind-driven waves and a significantly higher surge is attained. On September 11, 1961, when Hurricane Carla, a Category 4 storm, slammed into land near Port Lavaca, a 22-foot storm surge resulted in flooding as far inland as 10 miles. The majority of deaths that occur during a hurricane are the result of storm surge.

Speed of movement is an important factor in storm surge. Generally, slow-moving hurricanes will provide higher surges in the bays than the coast and fast-moving storms will produce higher surges at the coast than in the bay. Don't underestimate the dangers of a hurricane storm surge.

If the threat of storm surge is not enough to convince you to evacuate, consider that force caused by wind increases to the square of the wind speed. For example, wind speeds of 120 mph are four times as strong as 60 mph winds. Try walking into a 60 mph winds. Tornadoes are also a significant threat

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Q&A Questions and answers about hurricanes from the JSC Spaceflight Meteorology Group

What is the difference between a tropical disturbance, a tropical depression, a tropical storm and a hurricane?

A tropical disturbance is a discrete system of organized showers and thunderstorms that originates in the tropics and maintains its identity for 24 hours or more.

A tropical depression is an organized system of clouds and thunderstorms with a defined counterclockwise circulation with maximum sustained winds of 38 mph or less.

A tropical storm is an organized system of strong thunderstorms with a defined circulation and maximum sustained winds of 39 to 73 mph.

A hurricane is an intense tropical weather system with a well-defined circulation and sustained winds of 74 mph or greater.

How is a hurricane formed?

Hurricanes start as a cluster of showers and thunderstorms over tropical waters. A hurricane's main sources of energy are heat and moisture. Developing hurricanes gather this energy through contact with warm ocean waters. Water temperatures of 80 degrees Fahrenheit or warmer are typically needed for storm development.

Wind patterns are critical for tropical storm formation. The pattern most conducive to tropical storm formation is when low-level winds, below 5,000 feet, are converging and upper-level winds, above 25,000 feet, are light and diverging. Upper-level winds that are too strong will greatly inhibit tropical storm development, and often cause a hurricane or tropical storm to weaken.

What are the different parts of the hurricane?

The typical hurricane has two or three and sometimes more outer convective bands, also called feeder bands. These bands are comprised of cells resembling ordinary thunderstorms and can be up to 300 miles from the eye. The outer convective bands are generally 40 to 80 miles apart and come in advance of the main rain shield.

The rain shield is a solid area of rain that typically becomes heavier closer to the eye. The outer edge is well-defined and its distance from the eye varies greatly from storm to storm. Spiral bands or convective rings are regions of active showers and thunderstorms that encircle the centers of hurricanes. They are prevalent in more intense hurricanes and curve cyclonically inward toward the center of the storm where they appear to merge to form the eye wall.

The eye wall is an organized band of thunderstorms that immediately surrounds the center or eye of a hurricane. It typically contains the fiercest winds and most intense rainfall.

The eye is a relatively calm center of the hurricane. The winds are light, and skies may be partly cloudy or even clear. The average hurricane eye diameter is a little more than 20 miles. In general, when the eye is shrinking in size, the hurricane is intensifying. After the eye's passage, the violent wind blows in the opposite direction it was before the eye moved over an area and the heavy rain returns.

What is a storm surge?

A storm surge is a large dome of water often 50 to 100 miles wide that sweeps across the coastline near where a hurricane makes landfall. Storm surges can range from four to six feet for a minimal hurricane to greater than 20 feet for the stronger ones. The stronger the hurricane and the shallower the offshore water, the higher the surge will be. This can cause severe flooding in coastal areas, especially when the storm surge coincides with normal high tides. Water weighs about 1,700 pounds per cubic yard; extended pounding by frequent waves can demolish any structures not specifically designed to withstand such forces. Along the immediate coast, storm surge is the greater threat to life and property, even more so than the high winds.

Hurricane Camille produced a 25-foot storm surge in Mississippi. Hurricane Hugo in 1989 generated a 20-foot storm tide in South Carolina. Hurricane Andrew in 1992 caused a 17-foot storm surge in southeast Florida.

Note, the elevation of JSC ranges from 15 to 23 feet, so a 20 foot storm surge could put the lowest elevations at JSC under five feet of water.

How much rainfall and flooding can a hurricane produce?

Hurricanes, tropical storms, and tropical depressions are capable of producing abundant amounts of flood-producing rainfall. During landfall, a hurricane rainfall of 6 to 12 inches is common. If the storm is large and moving slowly, greater amounts of rainfall can be expected. To estimate the potential rainfall amount (in inches), divide the storm's forward motion into 100. For example, a storm moving five miles per hour could produce 20 inches of rain.

What kind of damage can happen from the wind of a hurricane?

As winds increase, pressure against objects is added at a disproportionate rate. Pressure force against a wall increases with the square of wind speed; a threefold increase in windspeed gives a ninefold increase in pressure. A 25 mph wind causes about 1.6 pounds of pressure per square foot, and places 50 pounds of force on a four by eight sheet of plywood. In 75 mph winds, that force becomes 450 pounds, and in 125 mph winds, it becomes 1,250 pounds.

What about tornadoes?

Hurricanes also produce tornadoes, which add to the hurricane's destructive power. Typically, the more intense a hurricane is, the greater the tornado threat. When a hurricane brings its winds inland, the fast-moving air hits terrain and structures, causing increased low-level wind convergence due to friction. This, in turn, enhances atmospheric lifting which increases the threat of tornadoes. The greatest concentration of tornadoes occurs in the right front quadrant of the hurricane.

Who issues hurricane watches and warnings?

Hurricane watches, warnings and advisories are officially issued by the National Weather Service's National Hurricane Center in Coral Gables, Fla. Meteorologists at NHC specialize in hurricane and tropical storm forecasting. They continually monitor atmospheric and ocean conditions, evaluate an array of atmospheric computer models and issue watches, warnings and advisories on tropical storms and hurricanes. The Houston/Galveston National Weather Service Office in League City customizes tropical storm and hurricane watches and warnings for southeast Texas. The Spaceflight Meteorology Group further customizes watches, warnings and advisories for JSC management and emergency planning managers.

How accurate are hurricane forecasts?

The National Weather Service's National Hurricane Center in Miami, Fla., prepares the official hurricane watches, warnings and advisories for the U. S. and adjacent ocean areas. Major advances have been made in hurricane forecast accuracy during the past 25 years due to improved satellite imagery and more sophisticated computer models. The average 72-hour forecast position error is about 300 miles, and the average 24-hour forecast position error is about 100 miles. This distance can mean the difference between destructive winds and storm surges and merely "tropical storm" conditions. Hurricane intensity changes are quite difficult to predict and the best plan is to expect the worst. A good rule of thumb is to plan for a storm arriving one category stronger and 12 hours sooner than predicted. ■

WEB SITES FOR TROPICAL WEATHER

NWS National Hurricane Center
http://www.nhc.noaa.gov

NWS Houston / Galveston National Weather Service
http://www.srh.noaa.gov/hgx

FEMA and Lowes-sponsored Hurricane Central page
http://www.storm99.com

NWS Tallahassee Tropical Page
http://www.nws.fsu.edu/tropical

Dr. William Gray's Seasonal Hurricane Forecasts
http://tropical.atmos.colostate.edu/forecasts/index.html

University of Hawaii - Worldwide Tropical Storm Tracks
http://www.solar.ifa.hawaii.edu/Tropical/

National Oceanic and Atmospheric Administration (NOAA)
http://hurricanes.noaa.gov/